RESEARCH

Cariboo Forest Region

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The Effects of Forest Practices on Stream Temperature

INTRODUCTION

High summertime temperatures have been known to be a problem for spawning salmon in the Horsefly River for several decades. However, a formal Interior Watershed Assessment Procedure (IWAP) completed in 1998 did not directly address this issue because there is no accepted procedure for assessing stream temperature in British Columbia.

A key question has been the possible effect of temperature increases in small streams on the temperature of larger fish-bearing waters. This is a concern because reserves are not required on S4, S5, and S6 streams by the Riparian Management Area (RMA) Guidebook.

To help answer this question a literature review was completed on the effects of forest practices on stream temperature. Results of the review are documented in a technical report (Teti, 1998) that is available to forest managers. This extension note provides a summary of that report.

REPORT SUMMARY

Effects of Riparian Logging

The scientific literature clearly indicates that the removal of riparian vegetation increases the summertime temperature of streams. It also indicates that these temperature increases should be minimal in streams adjacent to clearcuts, where shading has been maintained by *effective* riparian buffers. Effective buffers are those which maintain shading of streams close to natural levels and is best measured by *angular canopy density*. See the sidebar on next page for an explanation of this term.

There is good evidence in the literature that fixed width buffers are less effective at minimizing stream temperature increases than buffers designed to minimize increases in angular canopy density. Because the Riparian Management Area Guidelines specify fixed width buffers, it is therefore likely that they would not maximize stream temperature protection per unit volume of timber left on site.

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Cumulative Effects

One of the most important implications from the literature is that the cumulative downstream effect of temperature increases in S6 streams (as expected where they are logged to their banks) would probably be small. According to researchers in the Western U.S., the cumulative temperature effects on third order streams due to heating of first and second order streams is expected to be minimal. Their work suggests that there is a diminishing benefit to be gained by riparian buffers on smaller non-fish bearing streams. In the case of a large size difference such as an S4 or S6 stream entering an S2, the literature suggests that the potential influence of the smaller stream would be negligible. However, where there is less of a size difference (eg. an S5 entering an S3) the potential effect would be proportionately greater.

Lakes

The literature review did not address the role of large lakes in controlling downstream temperature. However, large lakes are expected to have unique effects on downstream temperature that would overwhelm the effects of inflowing tributaries in late summer.

Thermal Recovery

The time required for "thermal recovery" after riparian logging will depend on the factors that affect solar radiation and the rate of revegetation. These include stream width, stream azimuth, local topography, biogeoclimatic zone, and microsite conditions. Incorporating thermal recovery into the management of stream temperature could be based on an empirical relationship between angular canopy density and years since logging, stratified by different types of sites. However, this requires additional work.

Local Implications

The literature review taps into an important and virtually free resource - research results already done and paid for by others! It identified several references which were very relevant to stream temperature issues in the Horsefly watershed, particularly the role of S6 streams.

A Horsefly River watershed technical committee formed by the Forest District Manager is using information from the review to help identify whether riparian reserves beyond those in the RMA Guidebook are needed. The committee recognizes that extrapolating such findings across large geographic and jurisdictional distances is subject to errors, therefore, research and inventory gaps are also being identified.

For more information, or to receive a copy of the full literature review, contact Patrick Teti at 250-398-4752 (pat.teti@gems7.gov.bc.ca).

References

Teti, Patrick A. 1998. The Effects of Forest Practices on Stream Temperature, A Review of the Literature. Unpub. Rpt. For the Ministry of Forests. 10 p.

Angular Canopy Density

Angular Canopy Density (ACD) has been suggested in the literature as a useful measure of stream shading at some point on a stream, or the average amount of shading over a stream reach. It is defined at a point on the stream as that portion of the sun's path between 1000 AM and 200 PM Standard Time which is obscured by vegetation. For example, if a particular rock in a stream is shaded for a total of one hour during that four hour period when the sun is highest (approximately 1100 AM to 300 PM Daylight Time), then the ACD at that point would be 25 percent. Because ACD varies with changing sun angles, it would normally be measured with respect to the sun's position during the period of late July to early September when the highest stream temperatures typically occur. Field measurements of ACD can be made with a slightly modified canopy densiometer.